> PUBLICATION
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HARVEST
2016

Quality of French wheat

AT DELIVERY TO INLAND COLLECTION SILOS

FranceAgriMer

ARVALIS
Institut du végétal

EDITORIAL

2016 HARVEST: A COMPLETELY ATYPICAL YEAR

The crops looked promising until the end of May 2016. The mild autumn and early winter had triggered a strong growth, an ample tillering and an early recovery in the plants. The end of winter and the beginning of spring were also favourable to their continued development: cool and rainy during the appropriate periods. Thereafter, an outstanding and sustained period of rain combined with an abnormal lack of sunshine brought a large quantity of problems. The volumes and quality of wheat from the Northern half of France were strongly affected by this, whilst the South remained relatively sheltered.
In 2016, the production of French wheat is estimated to be 24% lower than the average of the past five years, and reaches only 28.2 million tonnes. The reason: the historically low yields for this year, estimated to be 54q/ha, a consequence of few grains per ear and low thousand grain weights.

Inhomogeneous quality according to the production area

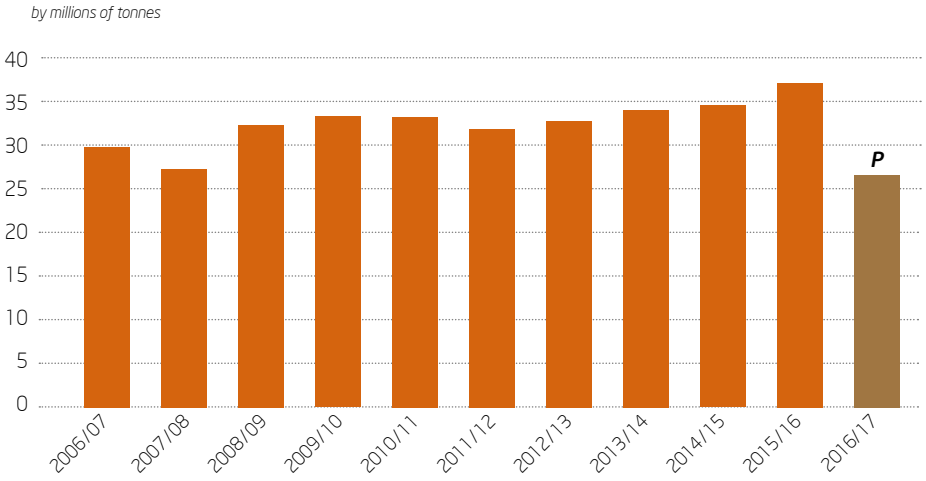
The extreme climatic conditions during the grain filling period were highly detrimental to the specific weights. While the five-year average (2011-2015) was 77.8kg/hl, only 25 % of wheat in 2016 is above 76kg/hl. The specific weights vary greatly from one region to another and gradually decrease from the South-West to the North-East. We must remember that this criteria is measured from samples taken at the time of delivery to inland collection silos, i.e. before the grain cleaning which increases the specific weights.
Protein contents are particularly high this year in the Northern half of the country in relation to the low yields. In the South, acceptable yields meet a satisfactory protein level. In total, 92% of French wheat has a protein content above 11.5%. Furthermore, the Hagberg falling numbers are good: 88% of wheat exceed 220 seconds. The water content of the grains, 13.6% on average at the time of delivery to collection silos, will allow them to be stored under favourable conditions.
Regarding technological quality, the baking strength, in correlation with the protein rate, increased with almost 92% of wheat over 170W. The doughs show a P/L average of 0.8 and 87% of wheat shows less than 1. However, despite a higher protein contents and good baking strengths, the bread-making grade according to the French grading table is generally average to low in most situations.

The French cereals sector has, for many years, strived to offer a high quality of production. 94% of our wheat area is seeded with bread-making quality wheat - the diverse varieties of which display complementary technological characteristics. In 2016, the very atypical climatic conditions led to the majority of wheat being classed in the Medium category of the French classification table. This is not an image of the normal quality of French wheat. Indeed, over the past five years, on average 45 % of wheat was in the "Premium" and "Superior" categories.

COLLECTION LEVEL

NATIONAL WHEAT COLLECTION TRENDS

> The collection, strictly speaking, represents the share of the harvest that is not used for on-farm consumption and consequently is marketed by the producers. Over the last five campaigns, the national harvest had stayed at a high level, between 31.7 and 39.9 million tonnes. Estimated at 26.4 million tonnes, the 2016/17 collection looks to be exceptionally low.

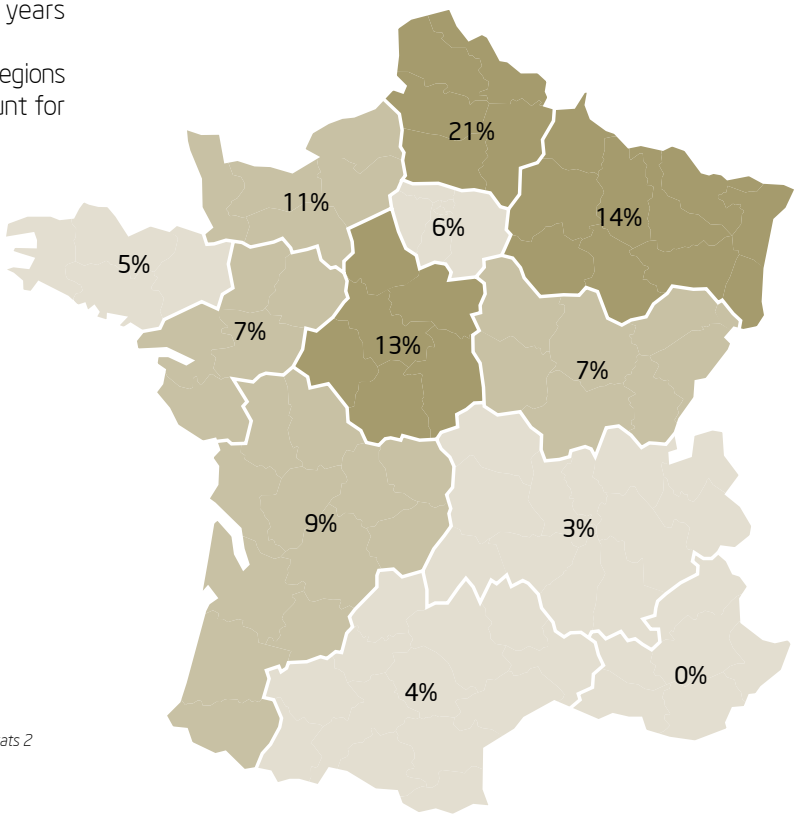


Source: FranceAgriMer, estimations from 14 September 2016 *P: provisional collection*

AVERAGED COLLECTION OVER THE PAST FIVE CAMPAIGNS

> The map opposite shows the contribution of each region to the national collection averaged over the last five marketing years (2011/2012 to 2015/2016).
The Northern half of France is the main collection area, and the regions of Hauts-de-France, Centre, Grand-Est and Normandie account for almost 60% of the total collection.

33.9 million tonnes on average collected over the **last 5 campaigns**



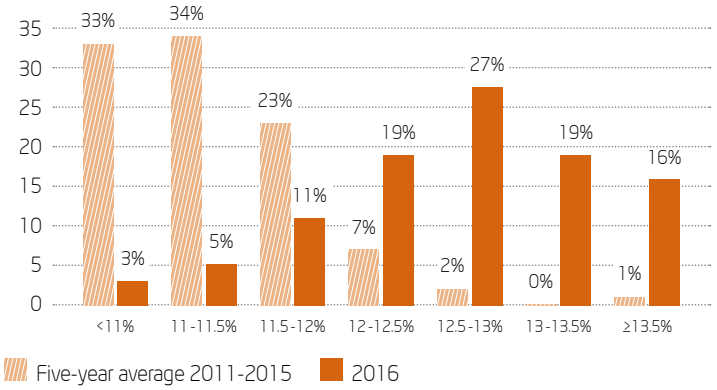
Source: FranceAgriMer/États 2

PROTEIN AND SPECIFIC WEIGHTS

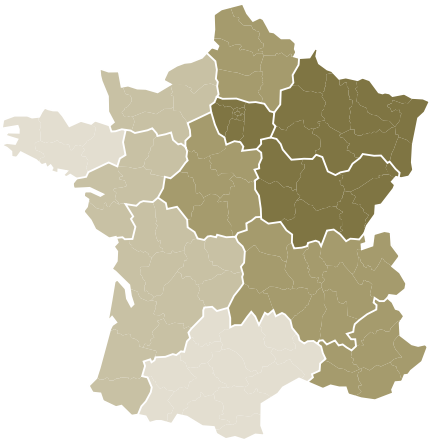
EXCEPTIONALLY HIGH PROTEIN CONTENTS

> The year's different climatic conditions resulted in great variations in protein contents between regions. The regional averages range from 11.3 to 13.4%, inversely proportional to the yields. In the South, the protein contents are in keeping with previous levels. On the other hand, they are very high in the Northern half of the country, above the levels normally observed in these regions. As a result, 92% of wheat is higher than 11.5%.

by % of volume collected



Source: FranceAgriMer / Inland silos quality survey 2016



Regional averages

- < 12%
- 12% to 12.4%
- 12.5% to 12.9%
- ≥ 13%

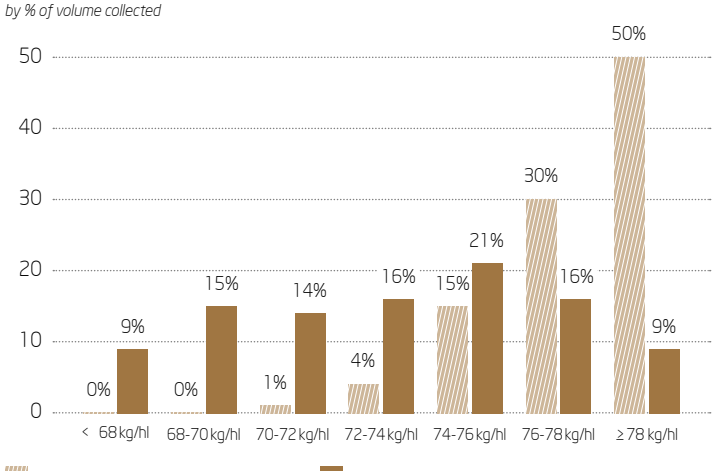
Source: FranceAgriMer / Inland silos quality survey 2016

92% of wheat shows a protein content of over **11.5%**

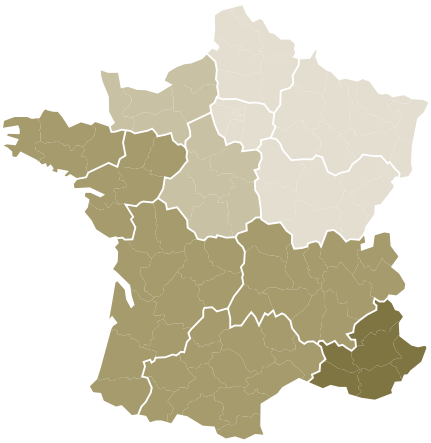
SPECIFIC WEIGHTS VARY DEPENDING ON THE REGIONS

> The extreme climatic conditions during the grain filling period were highly detrimental to the specific weights. While the five-year average was 77.8kg/hl, in 2016, only 24 % of wheat is above 76 kg/hl and 38% are below 72 kg/hl. The specific weight values are very mixed depending on the region: the highest was recorded in the South and the lowest in the North-East of France. Specific weights are measured from samples taken at the time of delivery to inland collection silos, but further cleaning and processing by the inland operators will increase the specific weight levels.

by % of volume collected



Source: FranceAgriMer / Inland silos quality survey 2016



Regional averages

- < 72 kg/hl
- 72 to 75.9 kg/hl
- 76 to 77.9 kg/hl
- ≥ 78 kg/hl

Source: FranceAgriMer / Inland silos quality survey 2016

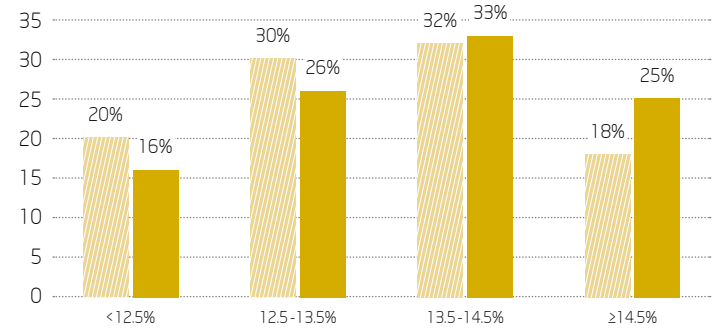
Levels higher than 76 kg/hl in the **6 regions** in the South and West of France

WATER CONTENT AND HAGBERG

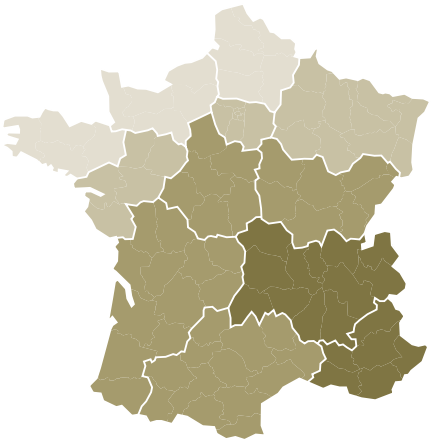
WATER CONTENTS ARE COMPATIBLE WITH THE NORM

> The water contents of the grain at the time of delivery to collection silos are 13.6% on average at national level. The regional values are lower than 13% for half of them. The regions in the North show higher values, as a result of more difficult harvest conditions, however, they do not exceed 15%.

by % of volume collected



Source: FranceAgriMer / Inland silos quality survey 2016



Source: FranceAgriMer / Inland silos quality survey 2016

Water content of

13.6%

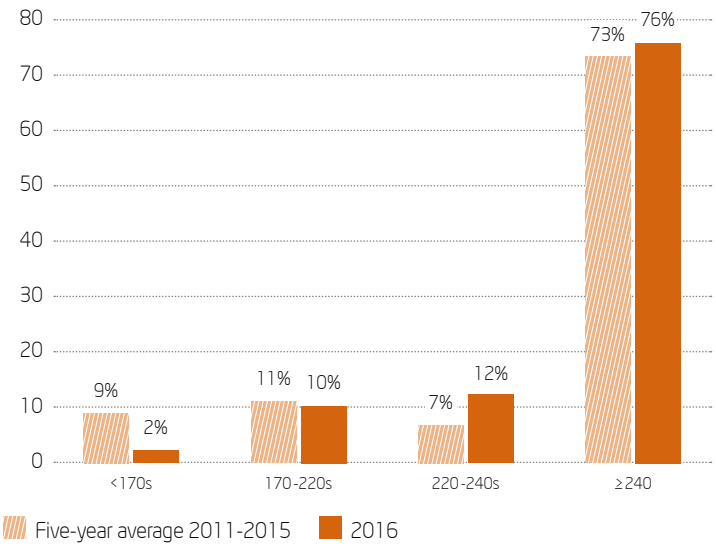
on average

HIGH HAGBERG FALLING NUMBERS

> Despite concerns caused by the weather conditions at the end of the cycle, the Hagberg falling numbers showed a very good level across the country. Globally, 88% of the harvest exceeds 220 seconds, and only 2% of the harvest scores below 170 seconds.

88 % of wheat above **220s**

by % of volume collected



Source: FranceAgriMer / Inland silos quality survey 2016

HARDNESS AND GLUTEN

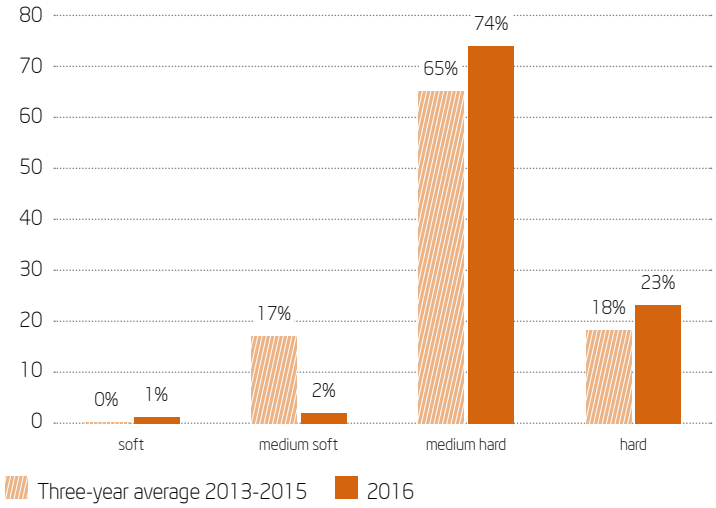
HARDNESS: A MEDIUM-HARD WHEAT

> Due to varietal evolution French wheat has been medium-hard and hard for the past twenty years or so. The average hardness, of 68 in 2016, is consistent with values of the previous years. 97% of the harvest is higher than 50.

97%
of wheat above **50**

Hardness

by % of volume collected



Source: FranceAgriMer / Inland silos quality survey 2016

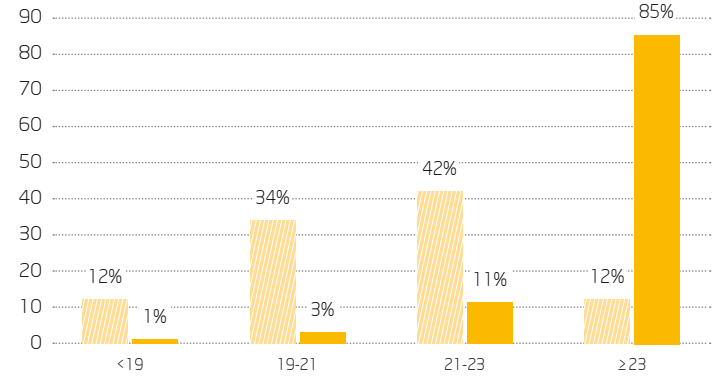
WET GLUTEN CORRELATES WITH THE PROTEIN CONTENT

> In relation to the protein contents, the wet gluten content is higher this year. The national average is 25.3%. 85% of wheat has a wet gluten content above 23%.

> The gluten index, an indicator of the quality of the proteins, is 75 on average, lower than the past three campaigns. Values spread over a large range, with the majority of wheat between 70 and 90 on the gluten index.

Wet gluten

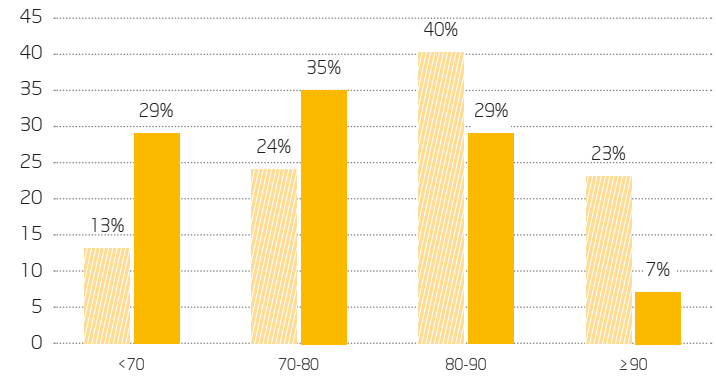
by % of volume collected



Source: FranceAgriMer/ARVALIS - Institut du végétal/Inland silos quality survey 2016

Gluten Index

by % of volume collected



Source: FranceAgriMer/ARVALIS - Institut du végétal/Inland silos quality survey 2016

ACCREDITATION NO. 1-0741 CAN BE ACCESSED AT WWW.COFRAC.FR

Analyses of the wet gluten content and the gluten Index, conducted by the Pôle Analytique d'ARVALIS, are covered by Cofrac accreditation no. 1-0741.

ALVEOGRAPHIC CRITERIA

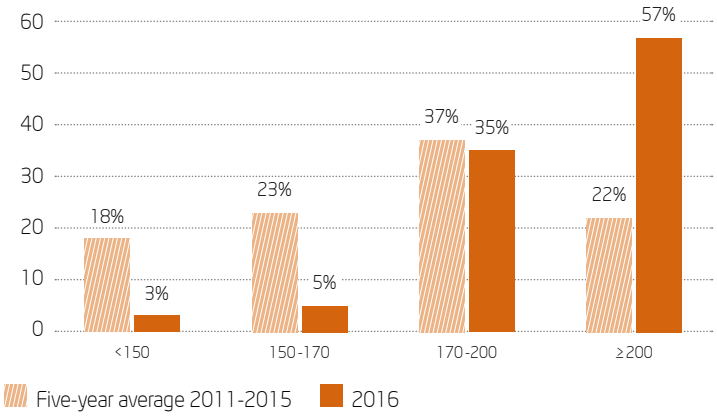
HIGH TO VERY HIGH BAKING STRENGTHS

> In relation to the high protein contents, the baking strength (W) is generally good this year. The national average is 205W. In 2016, 92% of wheat is above 170W and 57% is above 200 whereas French wheat is usually around 180.

92%
of wheat above **170 W**

Baking strength (W)

by % of volume collected



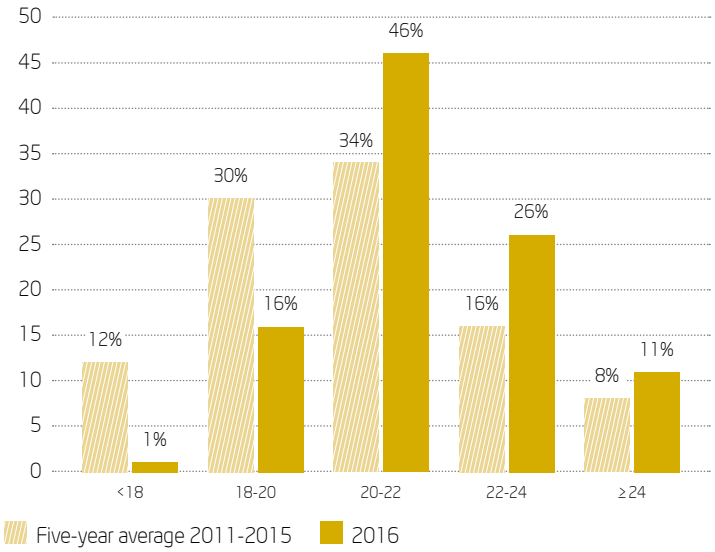
Source: FranceAgriMer / Inland silos quality survey 2016

G AND P COEFFICIENTS: A WIDE RANGE OF EXTENSIBILITY AND TENACITY

> On the Chopin alveograph, the doughs show the extensibility and tenacity characteristics allowing the various requirements of the milling industry to be met. On average, the G parameter is 21.6 and the P parameter is 71.2.

G

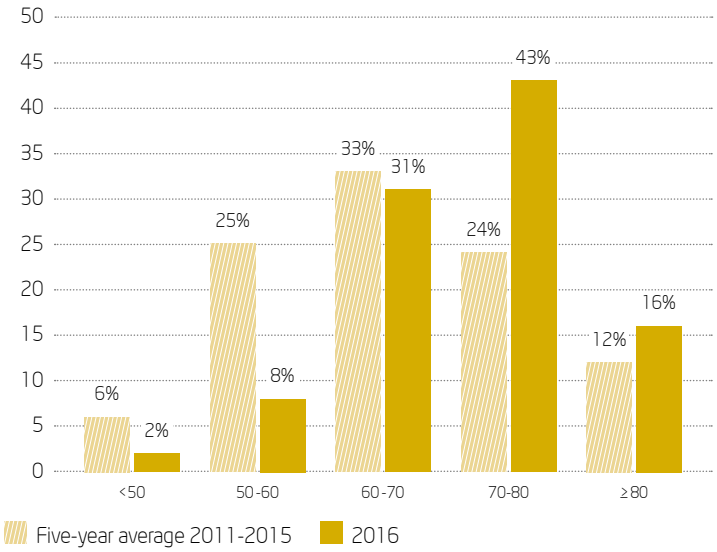
by % of volume collected



Source: FranceAgriMer / Inland silos quality survey 2016

P

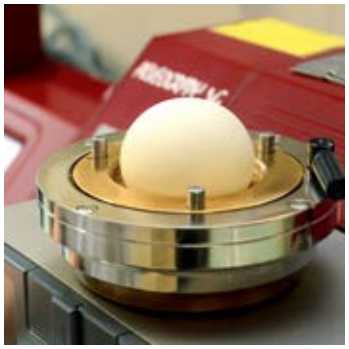
by % of volume collected



Source: FranceAgriMer / Inland silos quality survey 2016

Chopin alveograph measurements were taken on wheat with at least 10.3% protein contents and 180 seconds for the Hagberg Falling number value.

ALVEOGRAPHIC CRITERIA



WELL BALANCED P/LS

> In relation to the G and P coefficients, the P/Ls are well balanced. The national average is 0.8 and 87% of wheat shows a P/L of less than 1.

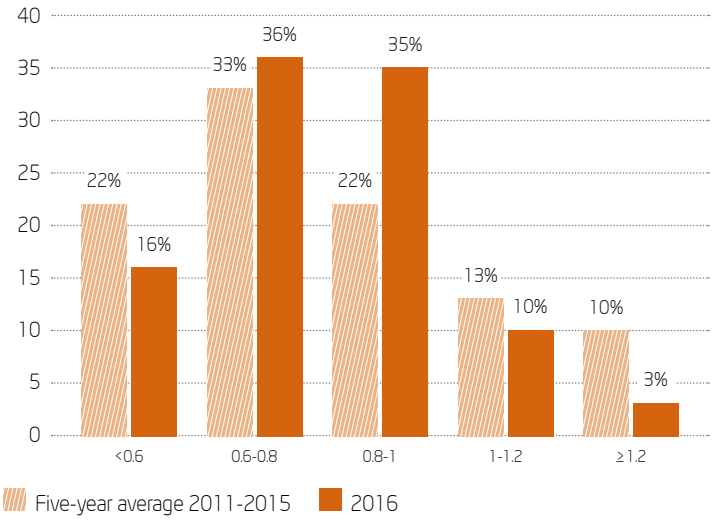
P/L:

87%

of wheat are less than 1

P/L

by % of volume collected



Source: FranceAgriMer / Inland silos survey 2016

ELASTICITY INDEXES COVER THE WHOLE RANGE

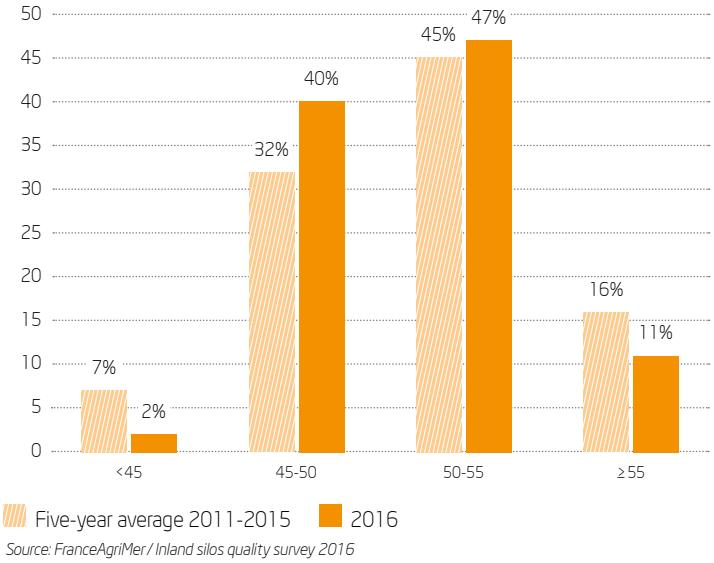
> The elasticity index (Ie) of the wheat reached 51 on average. The majority of the collected harvest stands between 50 and 55, corresponding to a rather well balanced dough during shaping in the bread-making process. 11 % of wheat produces a tenacious dough. Few wheat has a low elasticity index.

87%

of the harvest with a balanced elasticity index

Elasticity index

by % of volume collected



Source: FranceAgriMer / Inland silos quality survey 2016

Chopin alveograph measurements were taken on wheat with at least 10.3% protein contents and 180 seconds for the Hagberg Falling number value.

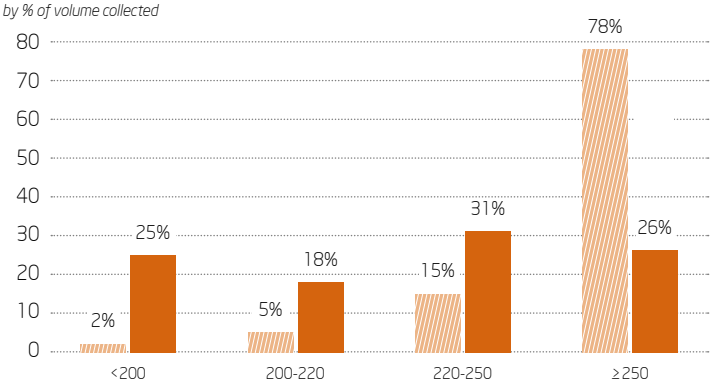
BAKING VALUE

GENERALLY AVERAGE TO LOW BREAD-MAKING BEHAVIOUR

> Despite the higher protein contents and the good baking strength, the bread-making behaviour is generally average to low in many situations. 26% of wheat scored according to the standard French bread-making test, showed a good baking quality, higher than 250. Almost 43% of the samples scored less than 220 out of 300. 31% of wheat analysed scored an intermediate baking value.

Total bread-making grade out of 300

by % of volume collected

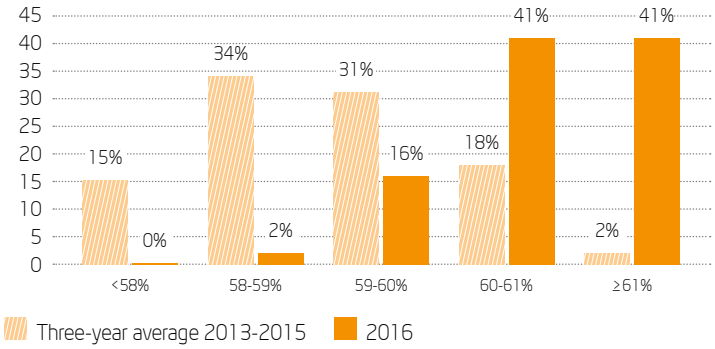


Source: FranceAgriMer/ARVALIS - Institut du végétal/Inland silos quality survey 2016

BREAD-MAKING CHARACTERISTICS

Water absorption

by % of volume collected



Source: FranceAgriMer/ARVALIS - Institut du végétal/Inland silos quality survey 2016

> Water absorption during kneading is of a very good level this year, with an average of 60.6%. Nearly 82% of the wheat have a water absorption higher than 60%.

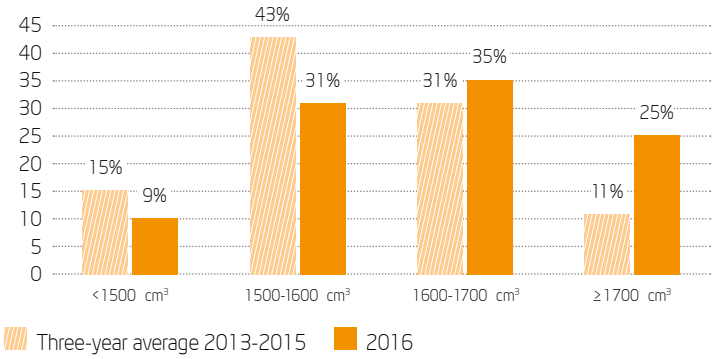
During shaping, the doughs are well balanced most of the time - neither too extensible nor too elastic. In certain cases fermentation can be significant and the dough slackens before being put in the oven.

Despite poorly developed blade marks, volumes are at a good level of 1650 cm^3 on average. 50% of wheat have a volume greater than 1600 cm^3.

This demanding test is not designed to optimise the final results, but to emphasise the wheats' distinctive characteristics in order to allow its best use into the various possible processes.

Volumes

by % of volume collected



Source: FranceAgriMer/ARVALIS - Institut du végétal/Inland silos quality survey 2016

The standard French bread-making test, conducted by the Pôle Analytique d'ARVALIS, is covered by Cofrac accreditation no. 1-0741.

ACCREDITATION NO. 1-0741 CAN BE ACCESSED AT WWW.COFRAC.FR

CLASSIFICATION OF WHEAT

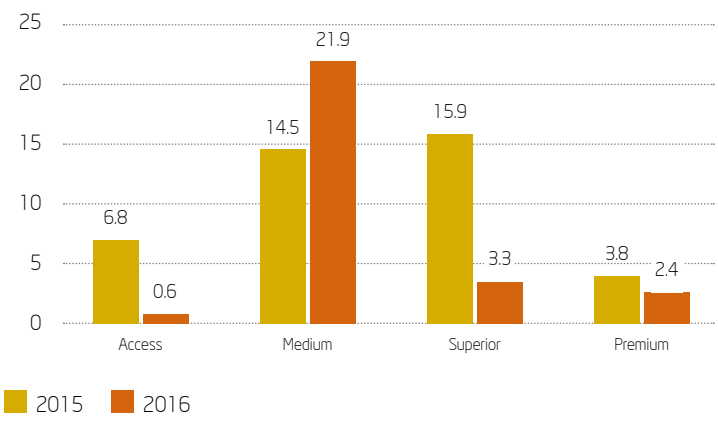
THE MAJORITY OF WHEAT WERE CLASSED AS MEDIUM: A VERY ATYPICAL YEAR

> The protein rate, baking strength (W), specific weight and Hagberg falling number value allow the collected wheat to be positioned within a four quality categories table.

This overview of the harvest depicts the French "average resource", in addition to the added potential brought by its diversity throughout the country.

Three of the four criteria show correct configuration. However, the low specific weight means that the majority of the wheat is classified in the "Medium" category, whilst, on average, over the past five years, 45% of French wheat has been classified "Premium" and "Superior".

by millions of tonnes (Mt)



Source: FranceAgriMer, estimation for the harvest from 9 September 2015/Inland silos quality survey 2016

CLASSIFICATION TABLE

Categories	Protein	W	Specific weight	Hagberg falling number value	National breakdown 2016	National breakdown 2011-2015
Premium	≥ 11.5%	≥ 170	≥ 77	≥ 240	**8%**	**15%**
Superior	≥ 11%	not specified	≥ 76	≥ 220*	**12%**	**30%**
Medium	≥ 10.5%	not specified	not specified	≥ 170*	**78%**	**37%**
Access	specified in the contract	not specified	not specified	not specified	**2%**	**18%**

Protein: (N x 5.7) % M.S.
Specific weight: kg/hl
W: 10^{-4} joules/g
Hagberg: seconds

* The Superior and Medium categories can be used without a Hagberg specification and in this case, the labels are "Superior" and "Medium"

Source: FranceAgriMer / Inland silos quality survey 2016

A SURVEY PERFORMED AT INLAND COLLECTION SILOS

The *Quality of French Wheat survey* is conducted by FranceAgriMer and ARVALIS - Institut du végétal, with the support of Intercéréales, the Association Nationale de la Meunerie Française (ANMF) and the Groupement National Interprofessionnel des Semences et Plants (GNIS).

The aim of the survey is to provide information on the quality of wheat harvested in 257 silos belonging to storage organisations, cooperatives and private merchants. At the time of the harvest, approximately 565 samples were taken by FranceAgriMer agents during delivery from farms to inland collection silos. Such samples are representative of the different sorting classes set up by the concerned inland collection silo. Then the samples are sent to the laboratories of FranceAgriMer and ARVALIS- Institut du végétal for analysis. Depending on the type of analysis, either all the samples, or a subset of them representing however the vast majority of the collected wheat of that site, were analysed.

ANALYTICAL METHODS

> Protein content - *565 samples*

The protein content is measured on whole grains by near infra-red spectroscopy.
It is calculated by using coefficient 5.7 and refers to dry matter (DM).

> Mass per hectolitre or specific weight (NF EN ISO 7971-3) - *565 samples*

It is obtained with a Niléma-litre and expressed in kg/hl on the sample as is.
Since 1st July 2012, the results obtained have then been corrected using the following equation: (0.9078 x mass per hectolitre) + 6.6025.

> Water content - *565 samples*

The water content is measured on whole grains by near infra-red spectroscopy.

> Hagberg-Perten falling number value (NF EN ISO 3093) - *565 samples*

This indirectly measures the level of alpha-amylase activity, which can become excessive due to the presence of grain which has germinated or is in the process of germinating. The falling number is expressed in seconds and corresponds to the time it takes a stylet to reach the bottom of a tube containing a mixture of milled wheat and water, immersed in a bath of boiling water. A short duration means high amylase activity and therefore a potentially degraded quality.

> Hardness index (AACC 3970.A) - *565 samples*

The hardness, or state of cohesion of the grain, is measured by near infra-red reflectance spectroscopy. The different classes of hardness (extra-soft, soft, medium-soft, medium-hard, hard and extra-hard) are expressed by an index on a continuous scale graduated from 0 to 100. By general standards, index 25 corresponds to the average value of wheat and index 75 corresponds to hard wheat.

> Wet gluten content and gluten Index (ICC 155) - *204 samples*

These values are used to assess:
- the quantity of gluten extracted by mechanically kneading and washing a mixture of milled wheat and salted water,
- the viscoelastic quality of gluten by centrifugation through a sieve, the higher the index, the more tenacious the gluten.

> Baking strength according to the CHOPIN alveograph test (NF EN ISO 27971) - *481 samples*

The alveograph test is performed on flour taken from a milled wheat sample, for samples whose protein content is above 10.3% and the Hagberg falling number is higher than 180 s. The CHOPIN alveograph tests weren't carried out on wheat classed as "fodder" by the harvesters. The measure is based on the recording of rheological behaviour of a disc of dough undergoing deformation in the form of a bubble. Five parameters are assessed: W, G, P, P/L and le. W represents the deformation of the dough. It gives a good indication of the baking strength. G, or rising index, represents the extensibility of the dough. P relates to the tenacity of the dough. The P/L ratio provides a measurement of the balance between tenacity and extensibility. Finally, the 'le' parameter expresses the elasticity of the dough.

> Standard French bread-making test (NF V03-716) - *51 samples*

The bread-making test is conducted on the flour from a milled wheat sample and on 50 representative samples of the collection. It is conducted in five stages: kneading, first fermentation, shaping, second fermentation and finally baking of the breads. Baking quality is assessed at each stage of the bread-making process and leads to a grade out of 300. It summarises 30 intermediary grades established by the baker for evaluating the characteristics of the dough, the bread as a whole and its soft centre. A bread-making grade which is lower than 200 indicates that the wheat is poorly adapted to French bread-making. On the other hand, a grade higher than 250 testifies to the dough's good bread-making quality.

NB: the previous results are shown as the five-year average (2011-2015) or the three-year average (2013-2015) depending on the date when the analyses were carried out.

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Groupement national interprofessionnel des semences et plants (Gnis)
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